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## (54) ROTARY PERCUSSIVE HAMMER

(71) We, FRIEDRICH DUSS MASCHINENFABRIK GmbH & Co., formerly FRIEDRICH DUSS MASCHINENFABRIK, of D 726L Neubulach, Germany (Fed Rep); a German company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement: —

The invention relates to a rotary percussive hammer, in which the percussive or boring tool insertable in a tool holder or the tool holder fitted with the tool have axial percussions imparted thereto by a pneumatically driven piston.

In known hammers of this kind pressure fluctuations in the air cushion are produced by means of pulsal compressed air or a piston driven by a crank. Generally, the tool or the tool holder is received directly in a reception (tool receiving member located in the housing region and impacted directly by the striker piston.

It is also known to insert between the tool holder and the tool a mass element which forms a unitary whole with the tool and the tool holder and serves to preserve the tool.

In the said hammers of conventional structure the mass of the tool, more especially the mass of the unit comprised of tool and tool holder, is relatively large. This mass means a loss of percussion energy. This loss is so large because in the tools in question the percussion frequency is high and the axial percussion amplitude is low. The percussion amplitude generally amounts to some tenths of a millimetre.

The object of the invention is to substantially reduce the said losses of percussion energy and with this to provide conditions for a higher percussion output or for a reduced number of the driving parts of the hammer with equal percussion force.

According to the present invention there is provided a rotary percussive hammer including a percussive or boring tool insertable in a tool receiving member, or a tool holder fitted with a tool and insertable into this tool receiving member, which has axial blows imparted thereto by a percussive piston, which is pneumatically reciprocatable in a cylinder, wherein the blows of the reciprocating percussive piston are transmitted to the tool, or a tool holder fitted with a tool, by means of an impulse transmitter member in the form of a rod or sleeve, which is mounted in a receiving sleeve for the tool or the tool holder, which sleeve is insertable in the tool receiving member of the hammer.

With such a development, the tool or the unit comprised of tool and tool holder may be made substantially shorter and hence also lighter in weight. Also the members for transferring the torque (e.g. hexagon or the like) which tend to increase the mass of the tool or the tool holder, may be omitted. Tests have shown that with the arrangement in accordance with the invention results in a surprisingly improved increase of the boring performance.

A further advantage consists in that the tool may be more quickly replaced and may be smaller and of simpler structure and hence can be manufactured more economically as a part subject to wear. Finally it is possible to adapt the hammer in accordance with the invention to a far higher degree to the given necessary percussion performance, in that a range of impulse transmitter members of varying mass, especially also those which are formed as a sleeve, may be used, since for determining the percussion intensity, the mass ratio between tool and tool holder, on the one hand, and the impulse transmitter of the percussion piston on the other hand plays a part.

In hammer drills of the aforesaid kind the tool is inserted in various ways into the tool receiving member and is secured against falling out by a yoke-like retaining spring, which, whilst allowing the possibility of axial play of the tool, engages around a neck of this tool or tool holder. This development known *per se* is subject to the difficulty that the tool at the beginning of the percussion or percussion boring operation is flung forwards when the tool is not actually performing any work pressure. This hurling operation each time causes a substantial stressing or loading of the tool receiving member of the retaining spring and the tool or the tool holder.

This difficulty has now been removed in that the receiving sleeve is prevented from dropping out by means of a pivotable retaining spring hinged to the housing and permitting limited axial play to this receiving sleeve, whereby this receiving sleeve does not participate in the transmission of the percussion impulses.

The present invention will be described further, by way of example, with reference to the accompanying drawings, in which:—

Figure 1 is a portion of a rotary percussion hammer shown in longitudinal section, with the tool locked;

Figure 2 is a section through part of the rotary percussion hammer of Figure 1 showing the tool locking region, the tool being disengaged;

Figure 3 is a section along the line III–III of Figure 1;

Figure 4 is a section along the line IV–IV of Figure 2;

Figure 5 shows the front view of the receiving sleeve of the rotary percussion hammer of Figure 1;

Figure 6 shows the shaft of the tool of the rotary percussion hammer;

Figure 7 is a section along the line VII–VII of Figure 6;

Figure 8 is an alternative embodiment of a part of the rotary percussion hammer insertable in the tool receiving member and comprised of the tool, impulse transmitter, receiving sleeve and locking sleeve;

Figure 9 is the front part of the receiving sleeve of the rotary percussion hammer;

Figure 10 is a further alternative in which the tool is received by a tool holder;

Figure 11 shows the tool intended for a percussion hammer which, e.g. is insertable into the receiving sleeve instead of the tool holder in Figure 10;

Figure 12 is a further alternative of the parts shown in Figure 8 and 10; and

Figure 13 is a section along the line XIII-XIII of Figure 12.

In the embodiment of Figures 1 to 7 a guide cylinder 11 is located in the housing part 10. A further housing part 21 encloses the so-called tool receiving member 17 of the hammer and is covered at the end face by a dust cap 22 with securing rim 22′. Between the rotating tool receiving member 17 and the housing part 21 a stationary bearing sleeve 20 is arranged. In the guide cylinder 11 the percussion piston 12 with sealing ring 13 is separated by an air cushion 14 from a piston (not shown). The torque of the driving motor is adapted to be transmitted via the shaft 18 supported in the bearing 19. The shaft 18 has a pinion 18′ engaging a gearwheel 17′ of the tool receiving member 17. The gearwheel 17′ is retained spaced from the collar 11′ of the guide cylinder 11 by an axial bearing comprised of rings 15, 16. A stirrup-like retaining spring 35, 35′ pivotally mounted in the housing part 21 with its web 35′ engages around the neck 49 of the receiving sleeve 231. The sleeve 231 is mounted in the tool receiving member 17 of the hammer and at its front end accommodates the actual tool 331 (or a tool holder). The tool 331 is struck via a transmitter rod 341.

The tool receiving member 17 may optionally accommodate, as in known hammers, the tool or tool holder, or a unit comprised of receiving sleeves, impulse transmitters and on actual tool or tool holder with tool.

This optional usability of the hammer in one or the other manner provides a broadening of the possibilities of use and adaptation of the hammer. The percussion piston 12 is oscillated by pressure changes in the air cushion 14, which are produced by the piston (not shown), driven by a crank drive so as to be reciprocated in the guide cylinder 11. The transmitter rod 341 mounted in the receiving sleeve 231 is prevented from dropping out of the sleeve 231 by a lock arrangement 29, 30, 38, 50. This comprises a stop element 30 engaging in a recess 50 of the transmitter rod 341, which stop 30 is accommodated in a radial bore 38 of the receiving sleeve 231 and retained in the bore by a locking sleeve 29 located on the receiving sleeve 231.

On a radial flange of this locking sleeve 29 a coil spring 28 is supported which also abuts against a ring 26 displaceably mounted on the receiving sleeve 231. This ring 26 is engaged from behind by a further ring 25 which couples the ring 26 and locking sleeve 241, 241′ to from a unit 26, 25, 241, 241′. This unit is part of a further locking device and includes a catch 32 located in a recess 36 of the receiving sleeve 231, and covered by the portion 241 of the locking sleeve 241, 241′. The portion 241′ of the locking sleeve is of larger diameter than the portion 241, and encloses the locking device 29, 30, 38 for the rod 341 and the spring 28. The portion

241 of the locking sleeve has an eccentric groove 39 as is shown especially in Figures 3 and 4. Due to this groove 39 the catch 32 may move from its disengaged position shown in Figure 2 in a radial direction into the recess 37 of the tool 331 (or a tool holder) (locking position of Figure 1), when the locking sleeve 241 is rotated. In this position (Figure 1) the tool is secured against being pulled out axially without being obstructed in its percussion movement. In this position (Figure 1) the catch acts simultaneously as an engaging member for transmitting the torque from the receiving sleeve to the tool. The locking sleeve 241, 241′ may be located in either the locking or release position by means of a stop element 31 which engages a stop notch 40 of a collar 231′ of sleeve 231 by action of the spring 28, which axially pre-tensions the unit comprised of the rings 25, 26 and the locking sleeve 241, 241′. The position may be altered by manual rotation of the locking sleeve 241, 241′.

The embodiment of Figures 8, 9 differs from the embodiment of Figures 1, 7 in that the receiving sleeve is formed of two parts 232, 232′, which are connected in threaded interengagement and form a chamber 51. The impulse rod 342 has an end portion 342′ which is captive in the chamber 51 formed by the receiving sleeve 232, 232′. The impulse rod 342 abuts against the tool 332 subject to the action of a spring 41 which is supported between an annular shoulder of the end portion 342′ and a shoulder of sleeve part 232.

A spring 28 producing the axial pretension of the locking sleeve 242 is supported against an abutment disc 43 abutting the spring ring 42 supported on the receiving sleeve 232′. The spring 28 is enclosed by a plastics material jacket of sleeve 242, 242′ abutting against a ring shoulder 58 of the receiving sleeve 232′. An elongate stop element 31 (Figure 9) supported in locking sleeve 242 is retained in its given stop notch 40 of sleeve 232′ by means of locking sleeve 242, 242′ pre-tensioned by the spring 28.

In distinction from the embodiments of Figures 1 to 7 and the embodiment of Figures 8 and 9, in the embodiment of Figures 10 and 11 the tool 334 is not received directly in the receiving sleeve but in the taper of a tool holder 441. This tool holder is locked with its shaft in the receiving sleeve 233 in the same manner as the shaft of the tool 232 in the embodiment of Figures 8 and 9. The axial tensioning of the locking sleeve 243, provided with a plastics material jacket 243′, in abutment against the shoulder 58 of a collar 233′ of the receiving sleeve 233 is produced by a spring 28. Due to the axial pressure the stop projections 31 of the locking sleeve 243, 243′ are retained in engagement in suitable stop notches of the collar 233′ of the receiving sleeve 233.

A transverse bore 45 in the receiving mandrel 441 serves as an expelling slot.

The shaft of the chisel 333 shown in Figure 11 is formed like the shaft of the tool holder 441 in the embodiment of Figure 10. Consequently it is possible to insert this chisel into the receiving sleeve 233 and to lock it there in place of the tool holder 441.

In the embodiment of Figures 12 and 13 the receiving sleeve 234, extends into a hollow section 234′. In the section 234′ the tool holder 442, 442′ with receiving taper for the tool 335 is mounted so as to be axially displaceable and secured against dropping out by a locknut 46 which is in threaded engagement with the receiving sleeve 234′.

The head of the transmitter rod 344 is accommodated in a cylindrical recess 53 of the tool holder 442, 442′. The head of rod 334 acts as an abutment for a spring 41 supported against the receiving sleeve which biases the rod 334 against the tool holder.

The locknut 46 abuts with engaging members 46′ (Figure 13) against engaging surfaces of the flange 442′ to ensure the transmission of the torque of the receiving sleeve 234, 234′ to the tool holder 442, 442′.

The relative movement between the tool holder to the receiving sleeve is measured in accordance with the free space 48. This free space and the recess 53 is protected against contamination by a dust cap 47 which is secured to the locknut 46 and with an internal flange abuts against the jacket of the tool holder 442.

WHAT WE CLAIM IS:—

1. A rotary percussive hammer including a percussive or boring tool insertable in a tool receiving member, or a tool holder fitted with a tool and insertable into this tool receiving member, which has axial blows imparted thereto by a percussive piston, which is pneumatically reciprocatable in a cylinder, wherein the blows of the reciprocating percussive piston are transmitted to the tool, or tool holder fitted wth a tool, by means of an impulse transmitter member in the form of a rod or sleeve, which is mounted in a receiving sleeve for the tool or the tool holder, which sleeve is insertable in the tool receiving member of the hammer.

2. A hammer as claimed in claim 1, in which the receiving sleeve is retained by a spring connected to the housing of the hammer and permitting a limited axial play of the receiving sleeve.

3. A hammer as claimed in claim 1 or

2, in which the tool or tool holder fitted with a tool is secured in the receiving sleeve by means of a catch engageable by rotating a locking sleeve.

4. A hammer as claimed in claim 3, in which the catch is displaceable in radial direction by means of a recess in the locking sleeve for locking in a recess in the shaft of the tool or the tool holder.

5. A hammer as claimed in any of the preceding claims 3 or 4, in which the catch in the locking position abuts against an engaging surface of the shaft of the tool or the tool holder such that the torque of the receiving sleeve is transmitted via the catch mounted in the recess of the receiving sleeve to the tool or the tool holder.

6. A hammer as claimed in any of the preceding claims 3 to 5, in which the locking sleeve is lockable into either of at least two rotary positions which correspond to a locking and a release position.

7. A hammer as claimed in claim 6, in which the locking sleeve is lockable by means of a stop element which biases the locking sleeve in axial direction by means of a spring, by means of a stop element which is a part of this locking sleeve and engages in stop notches of a ring shoulder of the receiving sleeve.

8. A hammer as claimed in any of the claims 3 to 7, in which the spring axially biasing the locking sleeve is supported against a ring shoulder of the receiving sleeve or against an abutment disc secured to the receiving sleeve by means of a spring ring.

9. A hammer as claimed in claim 8, in which the spring is enclosed by a sleeve-like section of the locking sleeve.

10. A hammer as claimed in any of the preceding claims, in which the impulse transmitter is retained by a stop element located in a radial bore of the receiving sleeve, which stop element engages in a recess of the impulse transmitting member.

11. A hammer as claimed in any of the preceding claims 7 to 10, in which the load of the spring is transmittable via a ring mounted so as to be displaceable on the jacket of the receiving sleeve and a stop ring to the locking sleeve.

12. A hammer as claimed in any of the preceding claims, in which the impulse transmitting member abuts against the tool or tool holder subject to the bias of a spring.

13. A hammer as claimed in any of the preceding claims, in which the receiving sleeve is assembled from two parts, which are in threaded interconnection and form a chamber, in which a spring is mounted in abutment against a shoulder of the receiving sleeve and axially loads the impulse transmitter.

14. A hammer as claimed in claim 13, in which the head of the impulse transmitting member is held in the chamber of the receiving sleeve.

15. A hammer as claimed in any of the preceding claims 1 to 12, in which the receiving sleeve extends into a cup-shaped section into which the tool holder extends and is secured by a locknut in threaded engagement with the receiving sleeve.

16. A hammer as claimed in claim 15, in which the head of the impulse transmitting member acts as abutment to a spring supported against the receiving sleeve is held in a cylindrical recess of the tool holder.

17. A hammer as claimed in any of the claims 15 or 16, in which the locknut with engaging members abuts against engaging surfaces of the flange of the tool holder.

18. A hammer as claimed in any of the preceding claims 15 to 17, in which a free space is formed between the locknut and the flange of the tool holder for the axial play of the tool holder and is protected by a dust cap connected to the locknut.

19. A hammer as claimed in any of the preceding claims 2 to 18, in which the axial play of the receiving sleeve is determined by the length of the neck of the receiving sleeve, which is embraced by the web of the retaining spring.

20. A rotary percussive hammer substantially as herein described with reference to and as illustrated in Figures 1 to 7, or Figures 8 and 9, or Figures 10 and 11 or Figures 12 and 13 of the accompanying drawings.

POTTS, KERR & CO.,
Chartered Patent Agents,
15 Hamilton Square,
Birkenhead, Merseyside L41 6BR
and
27 Sheet Street
Windsor, Berkshire

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FIG.1

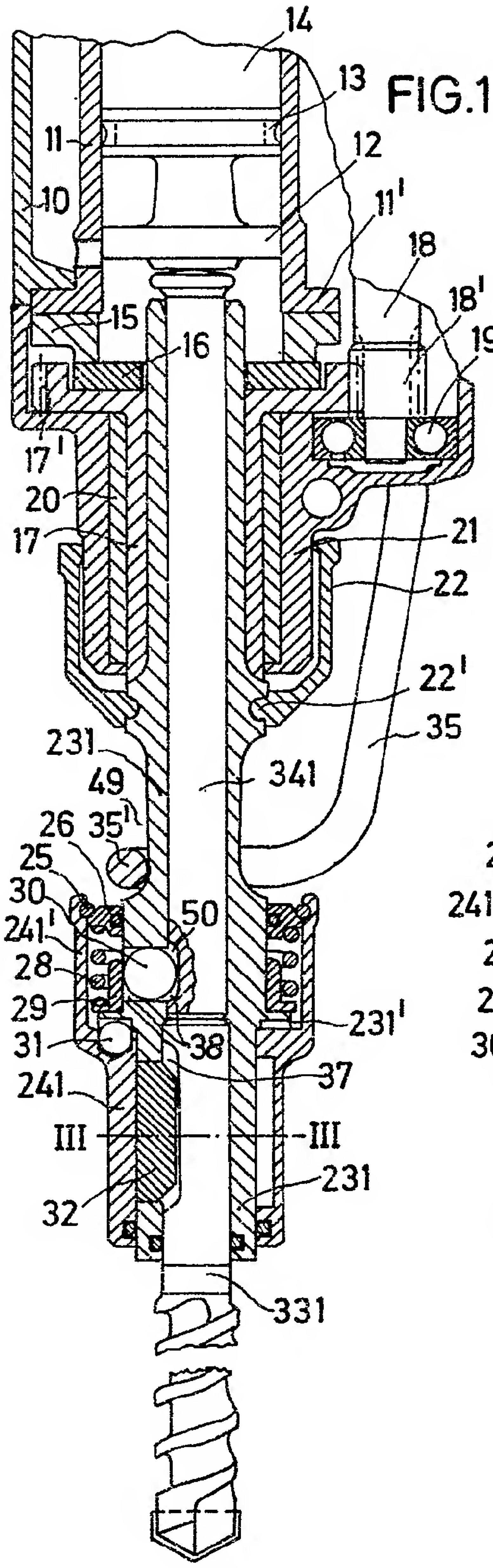



FIG.4

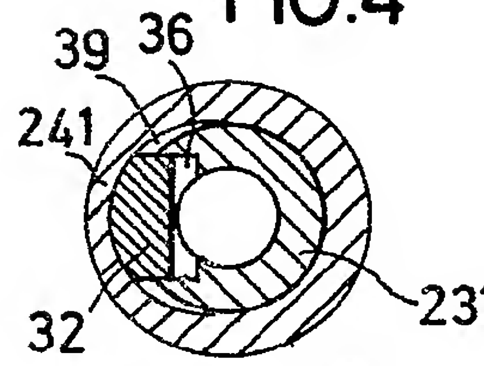



FIG.3

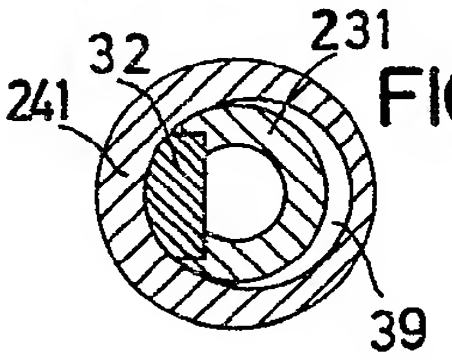



FIG.7

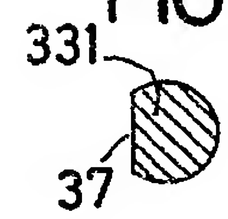



FIG.6

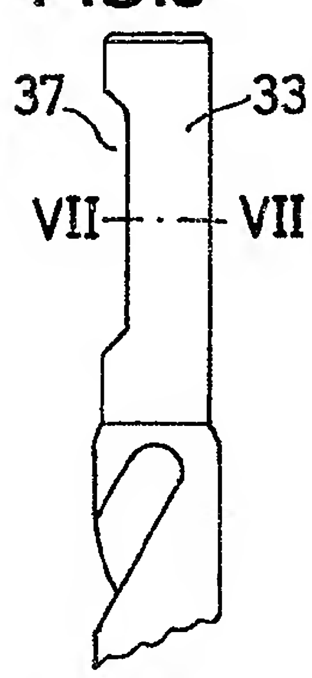



FIG.2

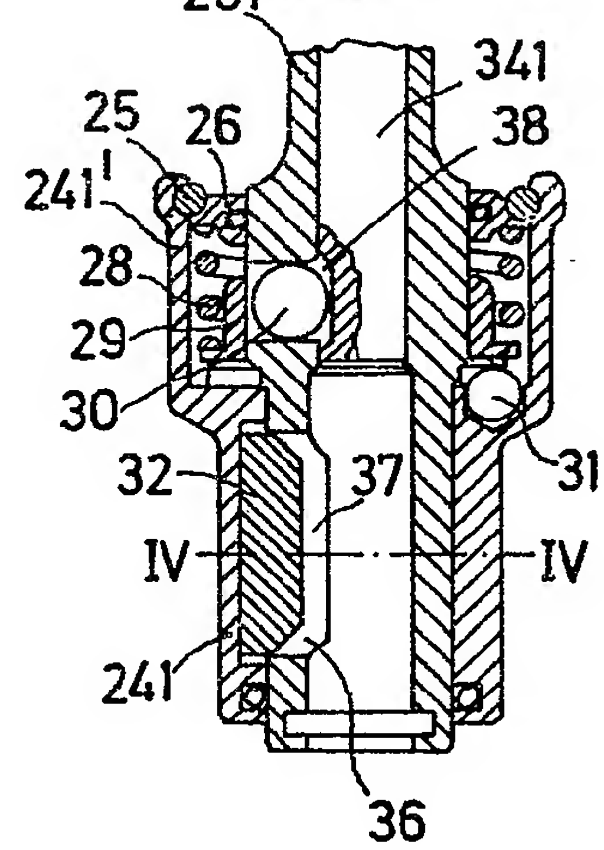
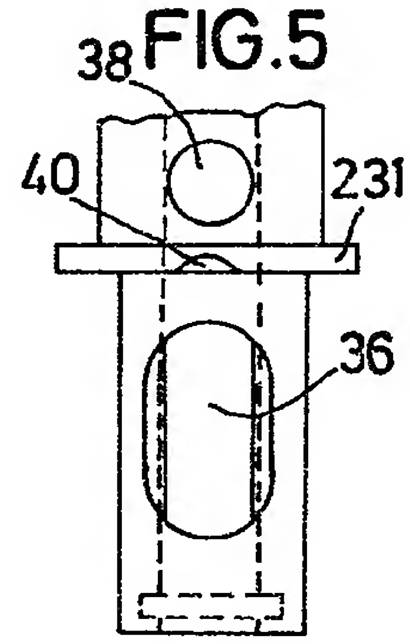



FIG.5



1 505 907 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale.*

*SHEET 2*

FIG.8

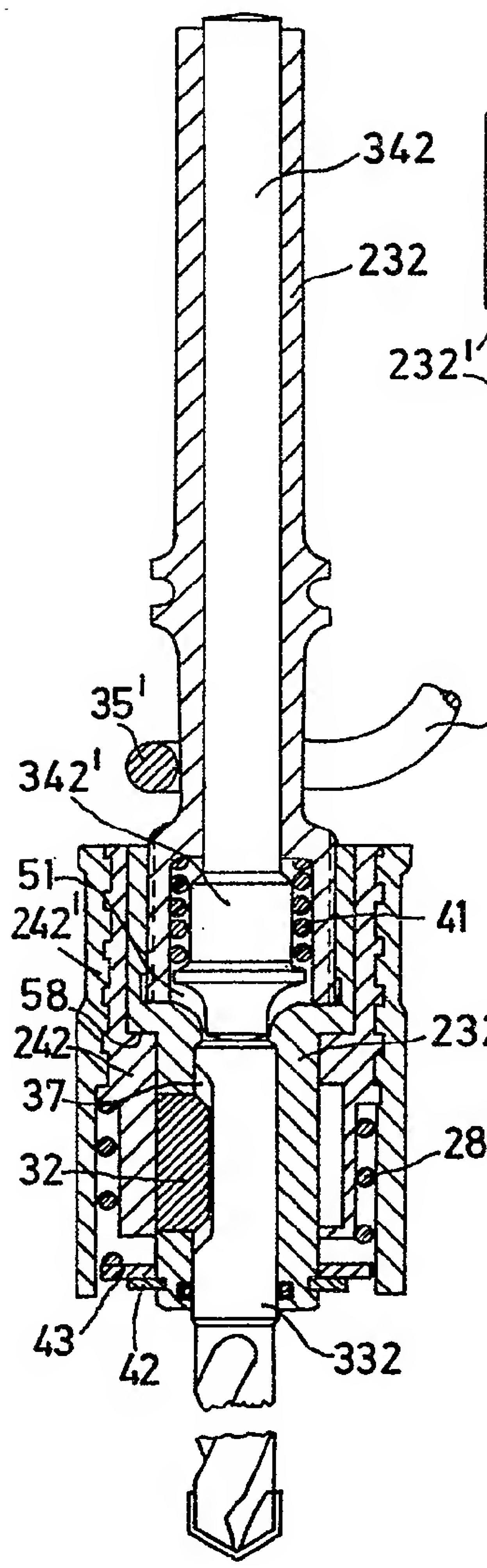



FIG.9

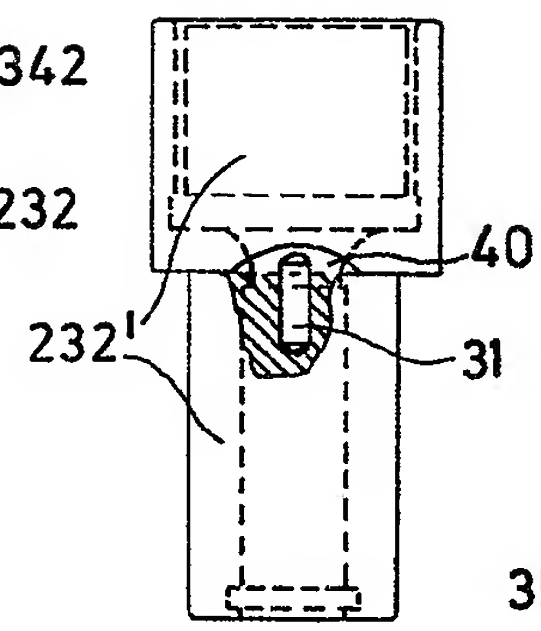
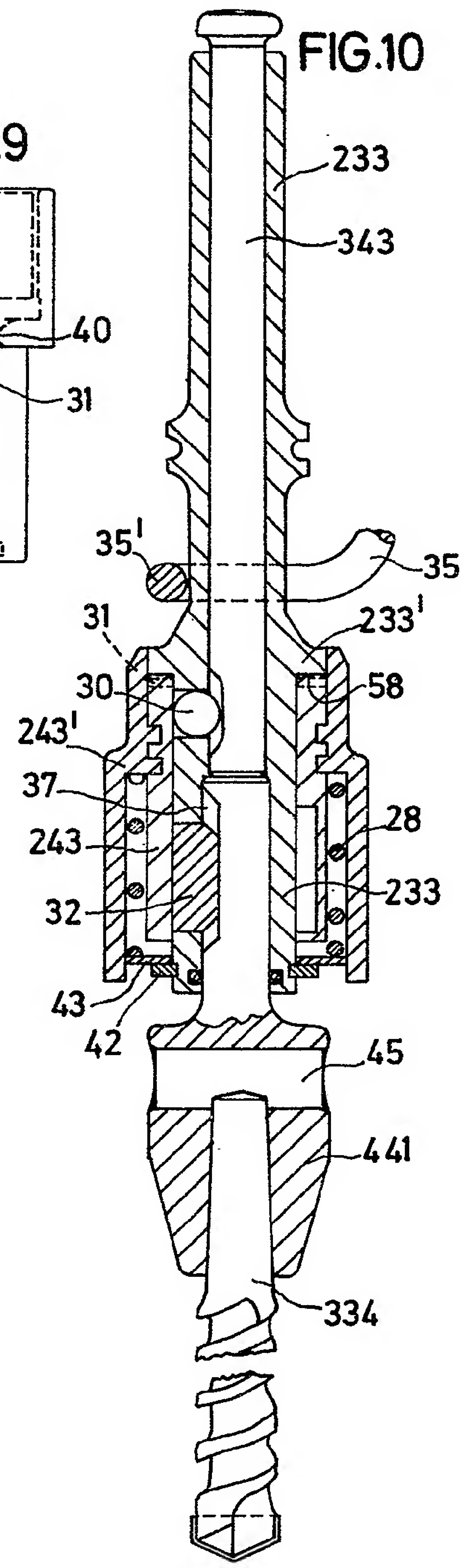



FIG.10



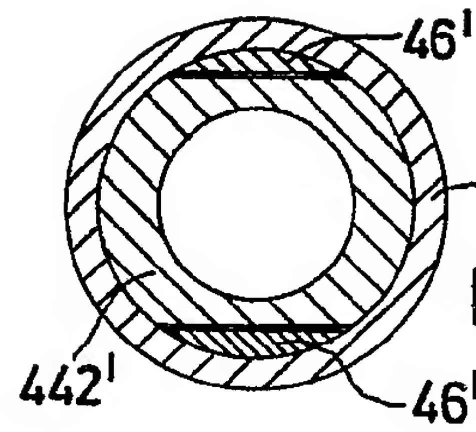



FIG.13

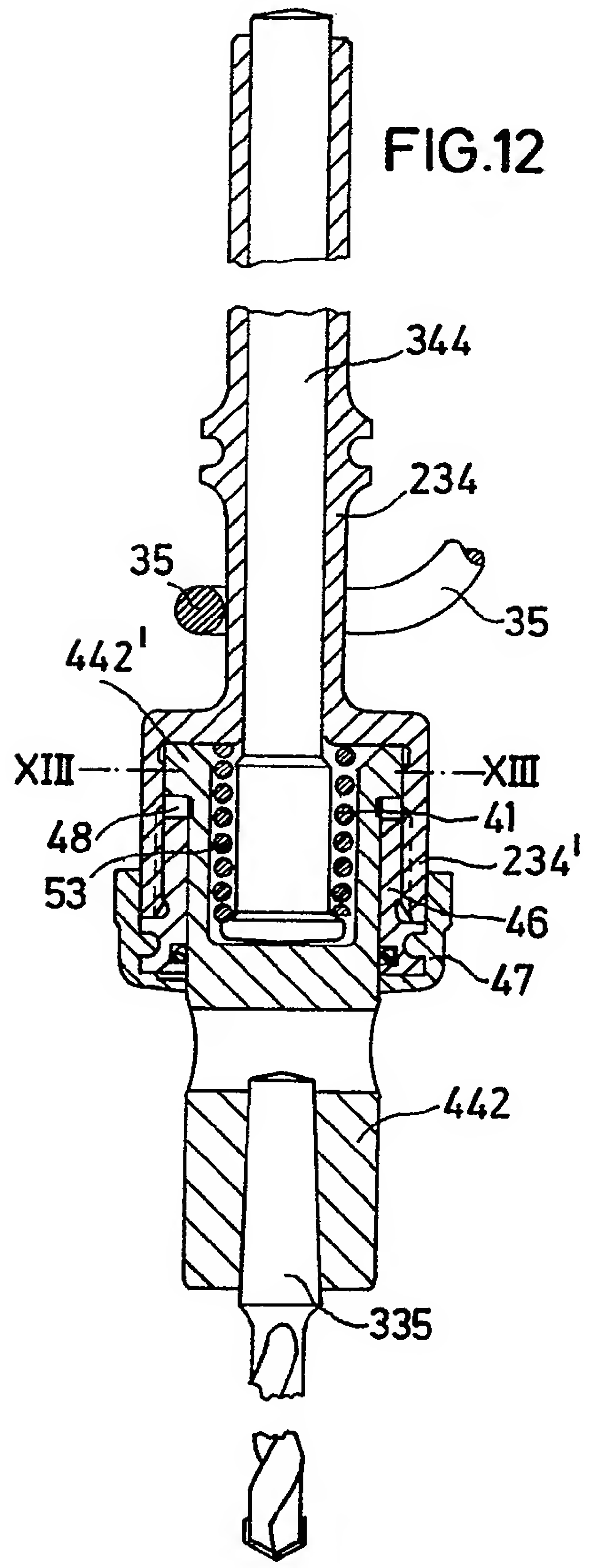



FIG.12

FIG.11